ON VERMICULUS LIMOSUS, A NEW SPECIES OF AQUATIC OLIGOCHÆTA.

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The present species is very common in the muddy gutters and ditches of our city, occurring together with *Limnodrilus*, *Tubifex* and other Limicolae. It creeps about on the lower surface of fallen leaves and other objects and rarely buries the anterior part of its body in the mud, as do most others; nor does it swing the posterior half of its body like the latter. The general color is tinged with a milky white and the intersegmental lines are blood red. It is very sluggish, and on being pinched never executes those writhing contractions, but simply retracts its body. These peculiarities serve to distinguish the present species readily from its cohabitants.

As measured on specimens killed with Perenyi's fluid after stupefying with weak alcohol, the body is 50—70 mm. long and 0.5—1 mm. wide. The segments number from 120 to 150 in sexually mature individuals. In the anterior part the body is cylindrical, but posteriorly it is somewhat flattened; the width gradually increases till about the middle of the body, but thenceforward it gradually diminishes. The prostomium is cylindrical and comparatively long. The clitellum is totally absent even in sexually mature specimens,—one point of difference from the known species of the genus, *Vermiculus pilosus* Goodrich.

The setæ are aggregated in bundles, which are arranged in four rows along the length of the body. Each bundle occupies in each segment the four corners of a square, and consists of 5—6 setæ in the anterior part and 2—3 in the posterior part; the setæ being all of the same size. Each bundle contains besides one or two small developing setæ in its setigerous sac. The setæ are all of the same form, being sigmoid and furcate at the end. There are no penial setæ.

The minute cilia-like processes on the body surface, supposed by Goodrich to be of a cuticular nature, can be observed with high powers; but in the present species they are closely set only in the posterior part of the body and gradually

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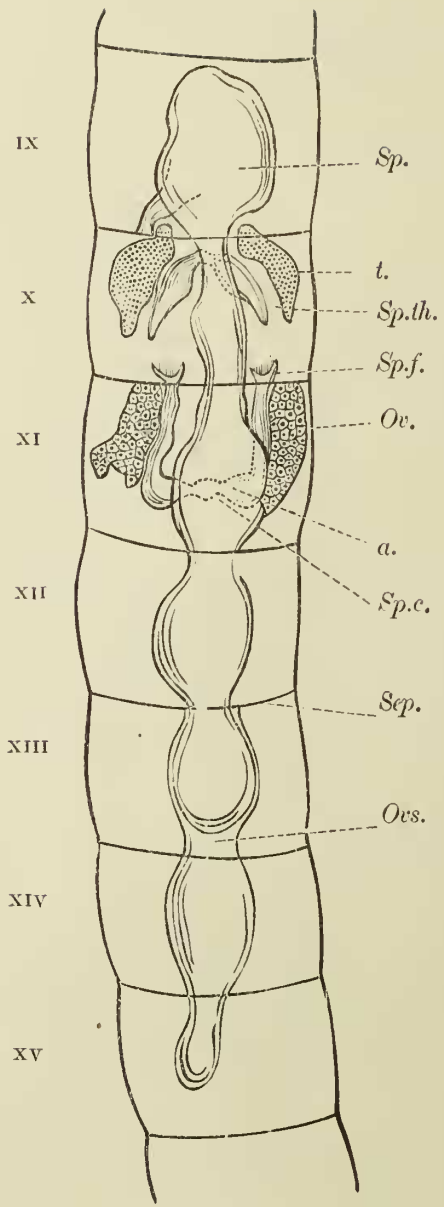
* Translated and edited by S. Goto.



Cut 1.

a. Atrium, *Ov.* Ovary, *Ovs.* Ovi-sac, *Sep.* Septum, *Sp.* Sperm-sac, *Sp.c.* Spermiducal chamber, *Sp.f.* Sperm-duct funnel, *Sp.th.* Spermatheca, *t.* testis.

decrease as we procced anteriorly. From the fifth segment on they appear to be entirely absent.

The cœlomic corpuscles are very numerous in segments II—X and hides the internal organs. In segment XI they are few, and gradually decrease in the more posterior segments, being very few in the segments next the anus.

The septa are thick; they are all set transversely to the alimentary canal, and are not funnel-shaped as is the case in the anterior segments of most other Oligochaetes.

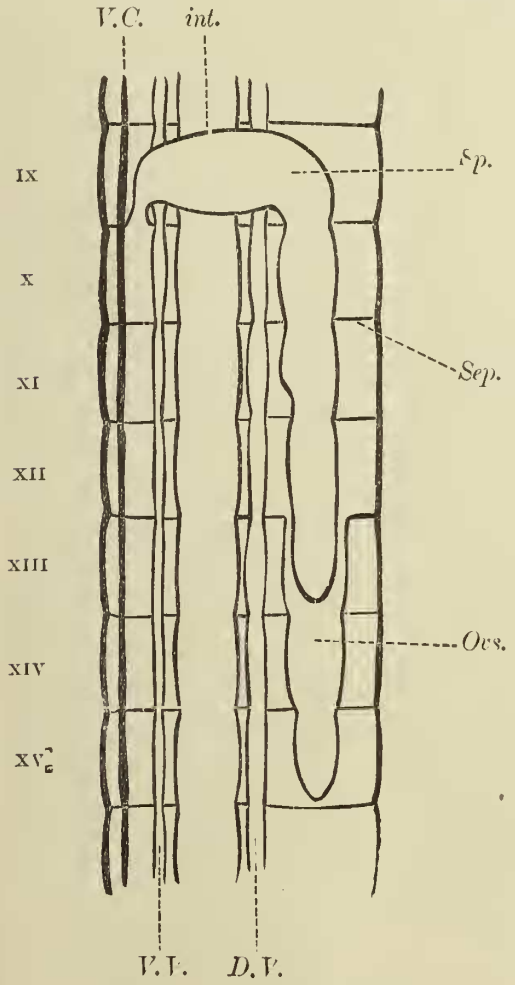
Genital System.

The genital organs present several points of difference from those of *V. pilosus*. I shall therefore describe them separately.

1. *Testes.*—One pair of testes are attached to the posterior face of septum IX/X, but a small portion of each testis projects into segment IX. The form varies according to development, but the posterior portion is usually finger-shaped.

2. *Sperm-sac.*—This is a single large sac extending from segment IX to segment XIII,

the larger portion of which lies on the dorsal side of the alimentary canal. In segment IX the posterior septum forms on the left ventral side an evagination towards the anterior, and this evagination is directly continued into the sperm-sac, which is very voluminous and is situated on the dorsal side of the intestine, in the median line. Of *V. pilosus* GOODRICH says (2, p. 261), "The spermatozoa are shed at an early stage of development into segment 10, and the anterior septum of this segment soon bulges out, forming a sac—the anterior sperm-sac. Later on this sperm-sac pushes its way across segment 9, through its anterior septum into segment 8. The hinder wall of segment 10 also bulges out, forming the posterior sperm-sac." In the new species before us these two sacs have become one and continuous. The walls of the sperm-sac are exactly like those of the ovisac to be presently described, and are covered with peritoneal cells on both surfaces. The hinder end of the sperm-sac projects into the cavity of the ovisac.



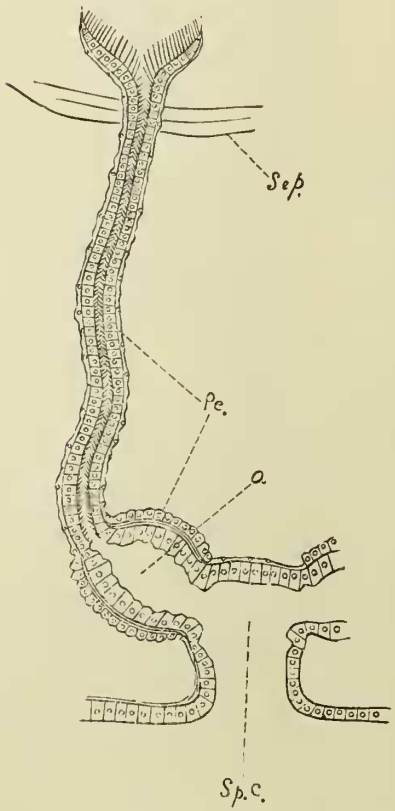
Cut 2.

D.V. Dorsal Vessel, *int.* intestine, *Ovs.* Ovisac, *Sep.* Septum, *Sp.* Sperm-sac, *V.C.* Ventral Cord, *V.V.* Ventral Vessel.

3. *Ovary.*—One pair attached to the anterior septum of segments X and almost reaching the posterior septum when fully developed, in which case the peritoneal covering is also very indistinct.

4. *Spermathecæ.*—One pair in segment X, spindle-shaped, and situated between the two testes, on either side of the intestine. The single coalesced duct opens to the exterior on the ventral median line, directly behind the intersegmental line IX/X. The internal surface of the sac is lined with a non-ciliated epithelium, which is followed by a layer of longitudinal and of circular muscle fibres. The external surface is covered with peritoneal cells. No spermatophores could be observed in the spermathecæ.

5. *Oviduct.*—In *V. pilosus* the oviduct is stated to be rudimentary, being represented by a pair of depressions of the 12th septum. In the present species no trace of the oviducts could be observed either in transverse or longitudinal sections.



Cut 3.

a. Atrium, *Pe.* Peritoneum, *Sep.* Septum, *Sp.c.* Spermiducal chamber.

6. *Ovisac* (*Receptaculum ovorum*).—One pair in segment XIII, being formed by the backward bulging out, on the left dorsal side, of the anterior septum, and extending sometimes into the 15th segment but sometimes stopping short in segment XIV. The mouth of the sac is very large and opens, as a matter of course, into the cœlom of segment XII. The anterior part of the ovisac encloses, as already stated, the hinder end of the sperm-sac, but the posterior part is slender. The ripe ova are found not only in the ovisac but also floating in the cœlom of this region. (In *V. pilosus* the ovisac opens into the cœlom of segment XI.)

7. *Sperm-duct.*—This is very different from that of *V. pilosus*. The funnel is relatively large and bores septum IX/X; it is continued into a slender duct, which, after running on the inner side of the ovary till about the

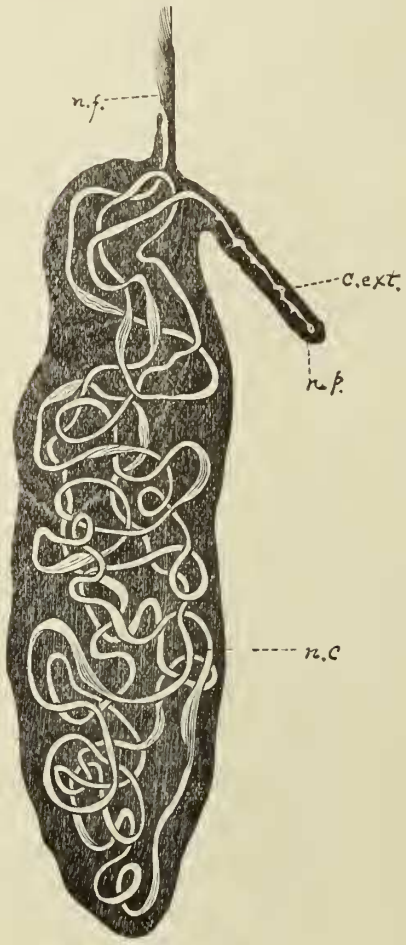
middle of segment X, curves slightly towards the median plane and opens into the atrium. The latter has a spacious ellipsoidal cavity and opens slightly in front of the setæ directly into the common sperm-duct chamber below the ventral cord, which is, as Goodrich says, to be regarded as an invagination of the body-wall. In immature individuals the atrium is followed by a slender duct-like portion, but as the genital organs approach maturity the invagination of the body-wall becomes greater and the dorsal wall of the duct-like portion is converted into the roof of the sperm-duct chamber, and the atrium comes to open directly into the latter. Even in mature specimens the sperm-duct chamber is sometimes very small and the duct-like continuation of the atrium persists. The internal surface of the funnel as well as of the duct is lined with ciliated epithelium, but in the atrium the cilia are absent and the cells are taller and glandular. The outer surface of the whole organ is covered with peritoneal cells, which are conspicuously taller around the atrium. Between the inner and the outer epithelium there is a layer of circular and longitudinal muscle fibres which are most strongly developed around the atrium and very thin in the funnel and the duct. There is no penis.

Alimentary Canal.

The alimentary canal is simple as in other Tubificidæ. The mouth lies on the ventral side of segment I; the pharynx is large and lies in segment II; the œsophagus is slender and extends through segments III and IV, the intestine beginning in segment V. The lumen of the intestine is about equal to that of the œsophagus, but as the former is surrounded by hepatic cells it appears externally thicker than the œsophagus. On the dorsal side of the pharynx there is a group of goblet-shaped unicellular glands with long necks opening into the basal portion of the ciliated epithelium of the pharynx. The ventral wall of the pharynx is very thick and is concave towards the ventrum. The œsophagus and the intestine are lined by a ciliated epithelium, which is followed by a layer of circular and of longitudinal muscle fibres. The intestinal wall is very rich in blood-vessels. In sections these are seen to be situated between the internal epithelium and the layer of circular fibres, and are traversed by connective tissue trabeculæ.

Nephridium.

The nephridia are present in segments VII—IX and in all segments posterior to XII inclusive except the last. In each nephridium we may distinguish three portions, the internal tubular portion, the middle enlarged portion, and the external tubular portion. The middle portion makes up by far the larger part of the whole organ, and reaches nearly the posterior septum of the segment on either side of the intestine; externally it is continuous with its fellow on the opposite side of the body, although the nephridial canals of the two are entirely separate. The external tubular portion opens to the exterior on the outer side of the ventral seta-bundle. The funnel is very small, and is somewhat sagitate or globular according as the ciliated process is thrown out or drawn in; the latter being formed by the ventral margin of the funnel. (In *V. pilosus* it is formed by the dorsal lip of the funnel.) The internal surface of the funnel as well as its margin is thickly covered with long vibrating cilia, and during life the ciliated process is contantly thrown out and drawn in. Sections show that there is a transverse constriction at its base, upon which it is folded when drawn in.



Cut 4.

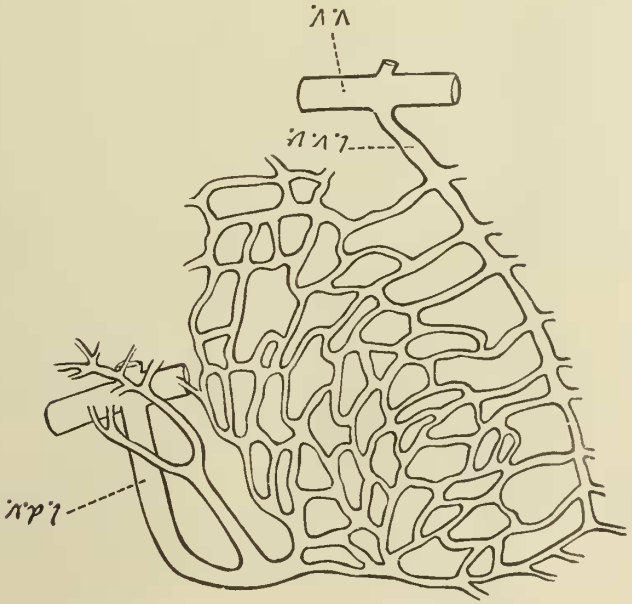
C.ex.t. Canal to the exterior, *nc.* Nephridial canal, *n.f.* Nephridiostome, *n.p.* Nephridiopore.

There is only one nephridial canal of small calibre, which winds back and forth several times in the enlarged middle portion. The portion lying between the nephridiopore and the middle portion, sends out several blind diverticula. The walls of the canal consist mostly of a syn-

citium, and the cell boundaries can be recognized only in the peripheral part. Here and there the canal is enlarged and forms the ciliated ampullæ.

Vascular system.

The main part are the dorsal and ventral vessels. The dorsal vessel divides into two in the prostomium, and these two vessels after dividing several times supply the brain and the body-wall of the most anterior part. The lateral vessels, which arise from the dorsal vessels, are very small in segments I, II, and III; they gradually become larger in segments IV—X, in which last segment they are considerably dilated. The largest lateral vessels lie, however, in segment XI, and from this on the lateral vessels are exceedingly small and just recognizable. The dorsal vessel alone beats, although the ventral vessel also executes some inconstant pulsatory movements. In each segment the dorsal vessel is provided with a group of valvular cells, which are also present in the constricted portions of the lateral vessels. These valvular cells are more numerous in the larger vessels; they are pear-shaped and contain a granular substance. The



Cut 5.

D.V. Dorsal vessel, *L.D.V.* Lateral dorsal vessel, *L.V.V.* Lateral ventral vessel, *V.V.* Ventral vessel.

dorsal lateral vessels are gradually enlarged from segment IV backwards, and the number of constrictions also increases.

The dorsal vessel divides into two also in the anal segment, in which it ramifies greatly.

The ventral vessel, like the dorsal vessel, sends out a pair of lateral vessels in each segment, which are continued into the corresponding vessels from the dorsal trunk, not directly as in most other oligochætes, but by the intermediation of smaller vessels.

The ventral vessel divides into two in segment III; these two branches proceed forwards and curving towards the dorsum in the first segment become continuous with the single dorsal vessel. A little in front of the point of separation of the two vessels just mentioned, these are united by a transverse vessel, from which is given off in the median line a branch which itself divides into two in segment I. These two vessels break up into smaller branches, which become continuous with the corresponding vessels of the dorsal side. Besides the lateral vessels corresponding to those of the dorsal vessel, the ventral vessel sends out another set of lateral vessels, which always alternate with the former.

The branching of the lateral vessels of the dorsal and ventral vessels is dissimilar. The dorsal lateral vessels divide successively, while in the ventral lateral we can recognize one main trunk, from which a number of smaller branches are given off symmetrically on either side.

In only a few among the many specimens that I have observed have I been able to demonstrate valvular cells in the ventral vessel; but their position is very variable, and they are mostly confined to the anterior part of the body.

Comparison of the two species.

	V. pilosus Goodrich.	V. limosus, n. sp.
Clitellum.....	X—XIII.	Wanting.
Sperm-duct.	Of uniform calibre throughout; only the middle portion appear swollen, owing to the tall peritoneal cells surrounding it; no atrium.	Gradually increases in calibre backwards; opens into a distinct atrium.
Nephridium.....	Begins in segment VI.	Begins in segment VII.
Oviduct.....	Rudimentary.	Absent.
Sperm-sac.....	Anterior sperm-sac in segment IX; none in X; posterior sperm-sac extending through segments XI—XII.	A single sperm-sac extending through segments IX—XIII.
Ovisac.	Formed by the posterior septum of segment XI.	Formed by the posterior septum of segment XII.
Cilia-like process...	Uniformly present.	Absent in the anterior portion, thickly set in the posterior portion.

In view of the characters of the new species above set forth we must read in the generic diagnosis given by BEDDARD "*Clitellum X—XIII or absent*" instead of "Clitellum X—XIII."

Literature on Vermiculus.

BEDDARD, F. E.—A Monograph of the Order of Oligochæta. 1895. P 271.
GOODRICH, E. S.—Note on a New Oligochæta. Zool. Anzeiger, XV. 1892. Pp. 474—476, 2 fig.
„ —On the Structure of Vermiculus pilosus. Quart. Jour. Mic. Sc, XXVII, N. S. 1895. Pp. 253 - 267, pl. 26—28.

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